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INTERLOCKED FLEXIBLE CONTACT ASSEMBLY FOR SHAFT

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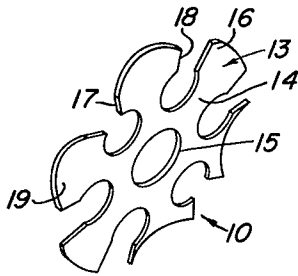


FIG 1

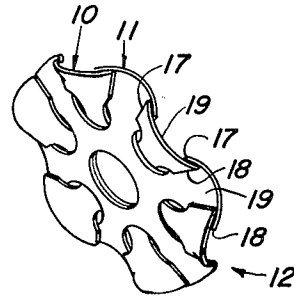


FIG 2

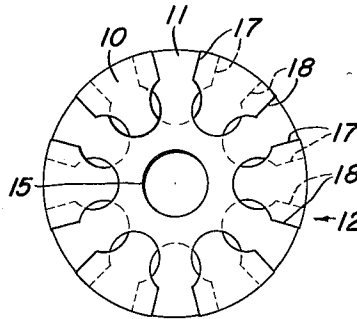


FIG 3

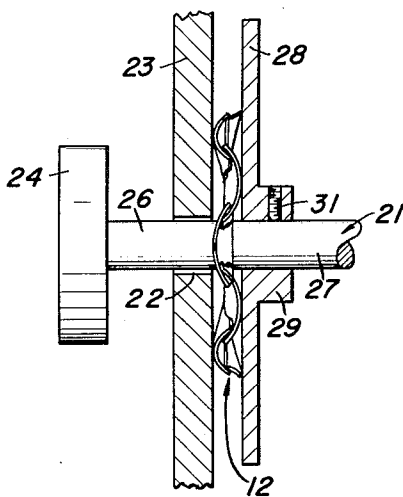


FIG 4

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1

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5 Claims. (Cl. 339—5)

This invention relates generally to contact assemblies and particularly to an interlocked flexible contact assembly.

At times, difficulty is encountered with high frequency electrical equipment due to radiation from shafts which extend from the interior to the exterior of such equipment. The back portion of such a shaft, which is inside of the apparatus, is generally adjacent to electrical components carrying high frequency energy; and high frequency energy is induced in the shaft by mutual induction. The energy travels along the shaft to its portion, external to the equipment, which acts as an antenna that radiates the energy into the surrounding atmosphere, where it may interfere with other electronic apparatus.

Although this type of radiation is tolerated with some types of equipment, it is very undesirable with other types such as signal generators. The radiation causes particular difficulty in the ultra-high frequency bands. It has been found that finger contacts, fastened to the panel, which slidably engage the surface of a shaft as it passes through the panel will not prevent energy from being radiated.

It is therefore an object of this invention to provide an electrical system which will pass to ground substantially all of the radio frequency energy carried by a metallic shaft used in electrical equipment before the energy passes out of the equipment, thus preventing radiation of the energy into the surrounding atmosphere where it would cause difficulty.

It is another object of this invention to provide an electrical contact assembly which will electrically connect a pair of metallic plates while permitting a wide range of spacing between them.

It is still another object of this invention to provide a contact assembly that is particularly useful because it has a great amount of flexibility.

It is a feature of this invention to provide a circular contact assembly that may be fabricated from identical members which may be stamped with the same die.

It is another feature of this invention to provide a flexible contact assembly which presents only smooth, rounded external surfaces on opposite sides and supports the radial edges of component members intermediate the opposite sides where the edges are slidable in a manner that permits great flexibility in the compression of the outer surface.

The invention provides an assembly which consists of a pair of radially symmetrical members that may be identically formed. The members are preferably made of thin resilient conducting material, such as Phosphor bronze. Each member has a plurality of arms equally dimensioned, which extend radially and are equally spaced from each other.

Each arm has a narrow inner portion and a wider outer portion. The width of the inner and outer portions of the arms may be defined in terms of the circumference of a circle positioned coaxially of the member and passed

2

through the respective portions. The outer portions are sufficiently wide so that their total width along the circumference of a circle passing through them is greater than one-half the circumference; and the total width of the inner portions along a circle passing through them is less than one-half the length of its circumference.

In each member, the outer portions of its arms are each formed with a curved shape; and the outer portions are arranged with their convex surfaces located on one side of the member and with their concave surfaces located on the opposite side of the member.

The contact assembly utilizes two members which have the concave sides of their respective arms engaging each other along their radial edges. The outer portions of the arms of one member are alternately interleaved with the outer portions of the arms of the other member, so that the radial edges of each outer portion of one member engages the concave sides of adjacent outer portions of the other member. Thus, the edges are internally positioned in the assembly by the interleaved construction; and the assembly provides only the convex surfaces of its outer portions on opposite sides to present only smooth, rounded surfaces to contact the surfaces of plate members received on both sides of the assembly. A hole is generally formed coaxially through both members so that the assembly may be received over a shaft.

Further objects, advantages and features will become apparent to a person skilled in the art upon further study of this specification and drawings, in which:

Figure 1 is a perspective view of one member used in the assembly of this invention.

Figure 2 is a perspective view of an assembly comprising this invention.

Figure 3 is an elevational view of the contact assembly shown in Figure 2.

Figure 4 is a side view, partially in section, showing how the invention may be situated in electronic equipment.

Now referring to the invention in more detail, Figure 1 shows a perspective view of a member 10 which is one of two identical members 10 and 11 that are shown in Figure 2 as an assembly 12 of this invention. Member 10 is formed radially symmetrical with a hole 15 located axially through it. A plurality of equally dimensioned arms 13 are supported radially in member 10. Each arm 13 has a narrow inner portion 14 and a wider outer portion 16; and the inner and outer portions have equal dimensions throughout the member.

The width of each inner portion 14 may be defined in terms of the circumference of a hypothetical circle drawn intersecting narrow portions 14 and having its center coincident with the center of member 10. Then, the sum of the widths of all of the narrow portions 14 lying on the circumference of the circle will be less than one-half of the circumference.

Similarly, the width of each outer portion 16 may be defined in terms of the circumference of a hypothetical coaxial circle intersecting each outer portion 16. The total width of outer portions 16 along the circumference is greater than one-half the length of the circumference.

Outer portions 16 are deformed in an arcuate manner and have their convex surfaces (not shown in Figure 1) all on one side of member 10 and their concave surfaces all on the other side of member 10, as shown in Figure 1.

The assembly shown in Figure 2 includes two members 10 and 11, and member 11 is formed exactly as member 10 in Figure 1. Members 10 and 11 are placed coaxially with respect to each other, but with the concave surfaces of their respective arms facing each other. The arms of member 10 are placed alternately among the arms of the other member 11; and the arms of the two

3

members are interwoven or interleaved with each other so that the radial edges 17 and 18 of each arm of one member engages the concave sides 19 of the adjacent arms of the other member.

A shaft 21 is shown in Figure 4 extending through a hole 22 in a panel 23, which may be part of any type of electronic apparatus. A knob 24 is fastened to the outer end 26 of shaft 21, while the inner end 27 of the shaft extends in the vicinity of unshielded ultra-high frequency circuitry (not shown).

A dial plate 28, which is an internal type, has a sleeve portion 29 coaxially received over shaft 21 and is fastened to it by means of a set screw 31. Dial plate 28 has numbering (not shown) around the outer parts of its surface, facing panel 23. Panel 23 is provided with a small hole (not shown) that aligns with any number on the dial, whereby a different number is observed through the hole for each different rotational position of shaft 21. The inner end of shaft 21 is supported by means not shown which maintains shaft 21 axially fixed.

Contact assembly 12 is received over shaft 21 between panel 23 and dial plate 28. Dial plate 28 rotates with shaft 21 and therefore rotates relative to panel 23. Hence, at least one of them rotates relative to contact assembly 12.

Panel 23 is received on one side of assembly 12 against the convex surfaces of the outer portions of member 10, while dial plate 28 is received on the opposite side of assembly 12 against the convex surfaces of the outer portions of the other member 11.

A slight amount of thrust is provided by bearings (not shown) of shaft 21 to maintain a small compression force on assembly 12. The force may be relatively small because the assembly is very flexible and readily gives as the spacing between panel 23 and dial plate 28 is narrowed. A small amount of force brings all of the convex surfaces of the assembly into engagement with the plates.

The force required to compress the assembly is not directly proportional to the change of spacing as would be the case with a conventional spring. This is caused, in part, by the sliding engagement of the concave surfaces during compression. It will be noted that as the curvature of arms 13 is made less, when contact assembly 12 is compressed, there is sliding among the edges of the arms and concave surfaces that they engage.

Because of the large amount of flexibility provided in the invention, the spacing between panel 23 and dial 28 is not critical and wide variation is permitted because of the invention. Thus, the shaft thrust bearing (not shown) is not required to provide a critical axial alignment for shaft 21 because of the contact assembly. Since contact assembly 12 only presents rounded convex surfaces to both the panel 23 and dial 28, there is no scoring of their surfaces by the assembly 12 during rotation of shaft 21.

Any high frequency energy that is picked up by the inner end 27 of shaft 21 is transmitted to dial plate 28 which is conductively connected to shaft 21; and assembly 12 provides a very low impedance path for the energy from dial plate 28 to panel 23, so that no energy can pass to the outer end of the shaft where it can be transmitted to the surrounding area. Each of the convex surfaces of the assembly firmly contacts its respective panel or dial plate surface and provides a low impedance path for the high frequency energy from the dial to the panel where it is grounded. The internal forces between the radial edges 17 and 18 and their engaged concave surfaces 19 caused by their interleaving maintains a very low impedance path from member 10 to the other member 11 in assembly 12.

Although the chosen embodiment has been described in conjunction with an internal dial plate, the invention may be used, for example, between an internally supported subassembly and a panel member where a shaft

4

extends from the subassembly through the panel. The invention then does not require the spacing between the subassembly and the panel to be critical because of the flexibility provided by the invention.

It is therefore apparent that the invention provides a contact assembly which will ground metallic members adjacent to a shaft used in high frequency electrical equipment to prevent radiation from that portion of the shaft which extends outside of the panel. Furthermore, it is noted that the interlocked flexible contact assembly obtains a great amount of flexibility which will permit a wide range of spacing between metallic plates connected electrically by the invention.

From the foregoing description taken in connection with the accompanying drawings, the uses and advantages of the invention will be readily understood by those skilled in the art to which the invention appertains. While the form of the invention which has been described is now considered to be the best embodiment thereof, it is understood that the elements shown and described are merely illustrative and that the invention is not to be limited to the details disclosed herein, but is to be accorded the full scope of the appended claims.

It is claimed that:

1. An interlocked flexible electrical contact assembly comprising, a pair of radially symmetrical members made of thin resilient conducting material, a plurality of arms formed in each member and extending in a radially symmetrical manner, each member having the same number of arms, each arm formed with a narrow inner portion and a wider outer portion, the outer portion of each arm deformed in an arcuate manner with the convex sides of the outer portions of a single member all arranged on the same side of that member, and the outer portions of the two members alternately interleaved so that the radial edges of each outer portion of one member are received against the concave sides of the adjacent outer portions of the other member, whereby the assembly only presents smooth rounded conducting surfaces on its opposite outer sides.

2. An interlocked flexible contact assembly comprising, a first member made of thin conducting resilient material and having a hole formed coaxially through it, a second member that is formed identically to the first member, each member formed with a plurality of radially extending arms, said arms having equal dimensional proportions and formed with a narrow inner portion and a wider outer portion, the total width of said narrow portions of each member being less than one-half the circumferential length of a hypothetical circle positioned coaxially of the member and passing through the narrow portions, the total width of said wider portions of each member being more than one-half of a circumference of a hypothetical circle passing through them, the outer portions formed with an arcuate shape, said two members assembled coaxially, said assembly having the outer portions of one member interleaved with the outer portions of the other member, the edges of the outer portions of one member being received against the concave surfaces of the adjacent outer portions of the other member, whereby only convex surfaces extend on opposite sides of the assembly.

3. An interlocked flexible contact assembly for electrically connecting two metallic plates comprising, a first member made of thin resilient conducting material, said first member formed radially symmetrical with a hole through its center, a plurality of arms formed in said first member extending radially outward from its center, the arms angularly spaced equidistant from each other with respect to the periphery of the first member, a second member formed similarly to the first member with the same number of arms and with the same diameter as the first member, the outer portion of each arm formed wider than its inner portion, the outer portions formed in a curved manner with a concave side and a convex

5

side, the convex sides of the arms all facing on one side of their respective members, the assembly comprised of said first and second members coaxially arranged and the outer portions of their arms alternately interleaved, the convex sides of the arms of the first and second members all facing outwardly of the assembly, whereby a wide variation in spacing is permitted between the metallic plates received on opposite sides of the assembly while electrical contact is maintained.

4. Means for preventing radiation from the external end of a metallic shaft extending through the outer wall of high frequency electronic apparatus and comprising, a metallic plate fastened transversely to said shaft in said apparatus adjacent to the outer wall, an annular contact assembly received over said shaft between the plate and outer wall, and said contact assembly comprising a pair of similarly formed members coaxially arranged, the members having a plurality of arms, each arm having a narrow inner portion and a wider outer portion, the arms of said members alternately arranged in the assembly with the outer portions partially overlapping each other, the overlapped portions of said arms interleaved, and the outer portions of the arms formed arcuate with only their convex faces extending on the outer opposite sides of the assembly, whereby the convex faces engage the plate and

6

outer wall to conduct high frequency energy from one end of the shaft to the outer wall and to thus prevent radiation from the other end of the shaft.

5. Means for preventing radiation from the external end of a metallic shaft extending through the panel of high frequency electronic apparatus and comprising, an inner plate supported within said equipment adjacent to the panel with the shaft passing through the inner plate, a flexible contact assembly received over said shaft between the inner plate and panel, said contact assembly comprising a pair of radially symmetrical members made of thin resilient conducting material, said members having an equal number of radial arms which are positioned alternately with respect to the members in said assembly, said arms having overlapping outer portions which are interleaved with the adjacent arms of the other member, said outer portions each formed arcuate, the convex faces of the outer portions located on the outer opposite sides of the assembly to contact the panel and inner plate, whereby the assembly self-adjusts its outer portions to the panel and inner wall to conform to their contour and alignment and to provide a conduction path between them.

No references cited.